## SEQUENCE LISTING

<110> Splawski, Igor Keating, Mark T.	
<120> ALTERATIONS IN THE LONG QT SYNDROME GENES KVLQT1 AND SCN5A AND METHODS FOR DETECTING SAME	
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<150> 60/190,057 <151> 2000-03-17	
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Phe Gln Gln Ala Arg Lys Pro Tyr Asp Val Arg Asp Val Ile Glu Gln

540

535

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Ile Thr Asp Met Leu His Gln Leu Leu Ser Leu His Gly Gly Ser Thr
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Thr Arg Glu Ser Leu Ala Ala Ile Glu Lys Arg Met Ala Glu Lys Gln
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		ttc Phe														816
		aac Asn 275														864
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ctg Leu	gcc Ala	ctg Leu	gcc Ala	cgc Arg 965	atc Ile	cag Gln	agg Arg	ggc Gly	ctg Leu 970	cgc Arg	ttt Phe	gtc Val	aag Lys	cgg Arg 975	acc Thr	2928
acc Thr	tgg Trp	gat Asp	ttc Phe 980	tgc Cys	tgt Cys	ggt Gly	ctc Leu	ctg Leu 985	cgg Arg	cac His	cgg Arg	cct Pro	cag Gln 990	aag Lys	ccc Pro	2976
gca Ala	gcc Ala	ctt Leu 995	gcc Ala	gcc Ala	cag Gln	Gly	cag Gln 1000	ctg Leu	ccc Pro	agc Ser	Cys	att Ile 1005	gcc Ala	acc Thr	ccc Pro	3024
Tyr	tcc Ser 1010	Pro	cca Pro	ccc Pro	Pro	gag Glu 1015	acg Thr	gag Glu	aag Lys	Val	cct Pro 1020	Pro	acc Thr	cgc Arg	aag Lys	3072
gaa Glu 102	Thr	cag Gln	ttt Phe	Glu	gaa Glu 1030	ggc	gag Glu	caa Gln	Pro	ggc Gly 1035	Gln	ggc Gly	acc Thr	ccc Pro	ggg Gly 1040	3120
gat Asp	cca Pro	gag Glu	Pro	gtg Val 1045	tgt Cys	gtg Val	ccc Pro	Ile	gct Ala 1050	Val	gcc Ala	gag Glu	tca Ser	gac Asp 1055	Thr	3168
gat Asp	gac Asp	Gln	gaa Glu 1060	Glu	gat Asp	gag Glu	Glu	aac Asn 1065	Ser	ctg Leu	ggc Gly	acg Thr	gag Glu 1070	Glu	gag Glu	3216
tcc Ser	Ser	aag Lys 1075	Gln	cag Gln	gaa Glu	tcc Ser	cag Gln 1080	Pro	gtg Val	tcc Ser	ggc Gly	tgg Trp 1085	Pro	aga Arg	ggc	3264
Pro	ccg Pro 1090	Asp	tcc Ser	agg Arg	acc Thr	tgg Trp 1095	Ser	cag Gln	gtg Val	tca Ser	gcg Ala	Thr	gco Ala	tcc Ser	tct Ser	3312
gag Glu 110	Ala	gag Glu	gcc Ala	agt Ser	gca Ala 1110	Ser	cag Gln	gcc Ala	gac Asp	tgg Trp	Arg	g cag g Glr	r caç ı Glr	ı tgç ı Trp	aaa Lys 1120	3360

gcg ga Ala Gl	a ccc u Pro	Gln	gcc Ala 125	cca Pro	ggg Gly	tgc Cys	Gly	gag Glu 130	acc Thr	cca Pro	gag Glu	Asp	agt Ser 135	tgc Cys	3408
tcc ga Ser Gl	u Gly	agc Ser 1140	aca Thr	gca Ala	gac Asp	Met	acc Thr 145	aac Asn	acc Thr	gct Ala	Glu	ctc Leu 150	ctg Leu	gag Glu	3456
cag at Gln Il	c cct e Pro 1155	gac Asp	ctc Leu	ggc Gly	Gln	gat Asp 160	gtc Va!	aag Lys	gac Asp	Pro	gag Glu 1165	gac Asp	tgc Cys	ttc Phe	3504
act ga Thr Gl 117	u Gly	tgt Cys	gtc Val	Arg	cgc Arg 175	tgt Cys	ccc Pro	tgc Cys	Cys	gcg Ala 1180	gtg Val	gac Asp	acc Thr	aca Thr	3552
cag go Gln Al 1185	c cca a Pro	ggg Gly	Lys	gtc Val 1190	tgg Trp	tgg Trp	cgg Arg	Leu	cgc Arg 1195	aag Lys	acc Thr	tgc Cys	Tyr	cac His 1200	3600
atc gt Ile Va	g gag ıl Glu	His	agc Ser 1205	tgg Trp	ttc Phe	gag Glu	Thr	ttc Phe 1210	atc Ile	atc Ile	ttc Phe	Met	atc Ile 1215	cta Leu	3648
ctc ac Leu Se	er Ser	gga Gly 1220	gcg Ala	ctg Leu	gcc Ala	Phe	gag Glu 1225	gac Asp	atc Ile	tac Tyr	Leu	gag Glu 1230	gag Glu	cgg Arg	3696
aag ac Lys Th	cc atc nr Ile 1235	Lys	gtt Val	ctg Leu	Leu	gag Glu 1240	tat Tyr	gcc Ala	gac Asp	Lys	atg Met 1245	Phe	aca Thr	tat Tyr	3744
gtc tt Val Ph 125	ne Val	ctg Leu	gag Glu	Met	ctg Leu 1255	ctc Leu	aag Lys	tgg Trp	Val	gcc Ala 1260	Tyr	ggc	ttc Phe	aag Lys	3792
aag ta Lys Ty 1265	ac ttc yr Phe	acc Thr	Asn	gcc Ala 1270	tgg Trp	tgc Cys	tgg Trp	ctc Leu	gac Asp 1275	Phe	cto	atc Ile	gta Val	gac Asp 1280	3840
gtc to Val Se	ct ctg er Leu	Val	agc Ser 1285	Leu	gtg Val	gcc Ala	Asn	acc Thr 1290	Leu	ggc	ttt Phe	: Ala	gag Glu 1295	Met	3888
ggc co Gly P:	cc ato ro Ile	aag Lys 1300	Ser	ctg Leu	cgg Arg	Thr	ctg Leu 1305	Arg	gca Ala	cto Leu	cgt Arg	cct Pro 1310	Let	aga Arg	3936
gct c	tg tca eu Ser 1315	: Arg	ttt Phe	gag Glu	ggc Gly	atg Met 1320	Arg	gtg Val	gtg Val	gto Val	aat Asr 1325	ı Ala	cto Lev	gtg Val	3984
ggc g Gly A 13	cc ato la Ile 30	ccg Pro	tcc Ser	· Ile	atg Met 1335	Asn	gtc Val	cto Leu	ctc Leu	gto Val	. Cys	c ctc s Leu	ato Ile	ttc Phe	4032
tgg c Trp L 1345	tc atc eu Ile	tto Phe	ago Ser	atc : Ile :1350	Met	ggc Gly	gtg Val	aac Asn	cto Leu 1355	Phe	gcç Ala	g ggg	aaq Lys	ttt Phe 1360	4080
ggg a	gg tgo rg Cys	ato	aac Asn 1365	Gln	aca Thr	gag Glu	gga Gly	gac Asp 1370	Leu	cct Pro	tto Lei	g aac 1 Asn	tao Ty: 137!	Thr	4128

atc gtg aac aac aag agc cag tgt gag tcc ttg aac ttg acc gga gaa Ile Val Asn Asn Lys Ser Gln Cys Glu Ser Leu Asn Leu Thr Gly Glu 1380 1385 1390	4176
ttg tac tgg acc aag gtg aaa gtc aac ttt gac aac gtg ggg gcc ggg Leu Tyr Trp Thr Lys Val Lys Val Asn Phe Asp Asn Val Gly Ala Gly 1395 1400 1405	4224
tac ctg gcc ctt ctg cag gtg gca aca ttt aaa ggc tgg atg gac att Tyr Leu Ala Leu Leu Gln Val Ala Thr Phe Lys Gly Trp Met Asp Ile 1410 1415 1420	4272
atg tat gca gct gtg gac tcc agg ggg tat gaa gag cag cct cag tgg Met Tyr Ala Ala Val Asp Ser Arg Gly Tyr Glu Glu Gln Pro Gln Trp 1425 1430 1435 1440	4320
gaa tac aac ctc tac atg tac atc tat ttt gtc att ttc atc atc ttt Glu Tyr Asn Leu Tyr Met Tyr Ile Tyr Phe Val Ile Phe Ile Ile Phe $1445$ $1450$ $1455$	4368
ggg tct ttc ttc acc ctg aac ctc ttt att ggt gtc atc att gac aac Gly Ser Phe Phe Thr Leu Asn Leu Phe Ile Gly Val Ile Ile Asp Asn 1460 1465 1470	4416
ttc aac caa cag aag aaa aag tta ggg ggc cag gac atc ttc atg aca Phe Asn Gln Gln Lys Lys Leu Gly Gly Gln Asp Ile Phe Met Thr 1475 1480 1485	4464
gag gag cag aag aag tac tac aat gcc atg aag aag ctg ggc tcc aag Glu Glu Gln Lys Lys Tyr Tyr Asn Ala Met Lys Lys Leu Gly Ser Lys 1490 1495 1500	4512
aag ccc cag aag ccc atc cca cgg ccc ctg aac aag tac cag ggc ttc Lys Pro Gln Lys Pro Ile Pro Arg Pro Leu Asn Lys Tyr Gln Gly Phe 1505 1510 1515 1520	4560
ata ttc gac att gtg acc aag cag gcc ttt gac gtc acc atc atg ttt Ile Phe Asp Ile Val Thr Lys Gln Ala Phe Asp Val Thr Ile Met Phe 1525 1530 1535	4608
ctg atc tgc ttg aat atg gtg acc atg atg gtg gag aca gat gac caa Leu Ile Cys Leu Asn Met Val Thr Met Met Val Glu Thr Asp Asp Gln 1540 1545 1550	4656
agt cct gag aaa atc aac atc ttg gcc aag atc aac ctg ctc ttt gtg Ser Pro Glu Lys Ile Asn Ile Leu Ala Lys Ile Asn Leu Leu Phe Val 1555 1560 1565	4704
gcc atc ttc aca ggc gag tgt att gtc aag ctg gct gcc ctg cgc cac Ala Ile Phe Thr Gly Glu Cys Ile Val Lys Leu Ala Ala Leu Arg His 1570 1575 1580	4752
tac tac ttc acc aac agc tgg aat atc ttc gac ttc gtg gtt gtc atc Tyr Tyr Phe Thr Asn Ser Trp Asn Ile Phe Asp Phe Val Val Ile 1585 1590 1595 1600	4800
ctc tcc atc gtg ggc act gtg ctc tcg gac atc atc cag aag tac ttc Leu Ser Ile Val Gly Thr Val Leu Ser Asp Ile Ile Gln Lys Tyr Phe 1605 1610 1615	4848

	eu Ile Arg Gly		atc cgc acg ct Ile Arg Thr Le 1645		4
gcc ctc atg at Ala Leu Met Me 1650	tg tcc ctg cct et Ser Leu Pro 1655	gcc ctc ttc Ala Leu Phe	aac atc ggg ct Asn Ile Gly Le 1660	g ctg ctc 499 u Leu Leu	2
ttc ctc gtc at Phe Leu Val Me 1665	tg ttc atc tac et Phe Ile Tyr 1670	Ser Il∈ Phe	ggc atg gcc aa Gly Met Ala As 1675	c ttc gct 504 n Phe Ala 1680	0
tat gtc aag to Tyr Val Lys Ti	gg gag gct ggc rp Glu Ala Gly 1685	atc gac gac Ile Asp Asp 1690	atg ttc aac tt Met Phe Asn Ph	c cag acc 508 e Gln Thr 1695	8
	er Met Leu Cys		atc acc acg to Ile Thr Thr Se 171	r Āla Gly	6
	eu Leu Ser Pro		act ggg ccg cc Thr Gly Pro Pr 1725		4
gac ccc act ct Asp Pro Thr Le 1730	eu Pro Asn Ser 1735	aat ggc tct Asn Gly Ser	cgg ggg gac tg Arg Gly Asp Cy 1740	c ggg agc 523 s Gly Ser	,2
		Phe Thr Thr	tac atc atc at Tyr Ile Ile Il 1755		0
			atc ctg gag aa Ile Leu Glu As		:8
gtg gcc acg ga Val Ala Thr Gl 178	lu Glu Ser Thr	gag ccc ctg Glu Pro Leu 1785	agt gag gac ga Ser Glu Asp As 179	p Phe Asp	6
	tu Ile Trp Glu		cca gag gcc ac Pro Glu Ala Th 1805		. 4
att gag tat to Ile Glu Tyr Se 1810	eg gtc ctg tct er Val Leu Ser 1815	gac ttt gcc Asp Phe Ala	gac gcc ctg to Asp Ala Leu Se 1820	t gag cca 547 r Glu Pro	2
ctc cgt atc gc Leu Arg Ile Al 1825	cc aag ccc aac a Lys Pro Asn 1830	Gln Ile Ser	ctc atc aac at Leu Ile Asn Me .835	g gac ctg 552 t Asp Leu 1840	.0
ccc atg gtg ag Pro Met Val Se	gt ggg gac cgc er Gly Asp Arg 1845	atc cat tgc Ile His Cys 1850	atg gac att ct Met Asp Ile Le	c ttt gcc 556 u Phe Ala 1855	8
ttc acc aaa ag Phe Thr Lys Ar 186	g Val Leu Gly	gag tct ggg Glu Ser Gly 1865	gag atg gac gc Glu Met Asp Al 187	a Leu Lys	.6
atc cag atg ga Ile Gln Met Gl 1875	u Glu Lys Phe	atg gca gcc Met Ala Ala .880	aac cca tcc aa Asn Pro Ser Ly 1885	g atc tcc 566 s Ile Ser	4

tac gag ccc Tyr Glu Pro 1890			Leu A			s Glu				5712
gcc atg gtt Ala Met Val 1905				Arg Arg				Arg		5760
ttg aag cat Leu Lys His		Phe Leu					Ser			5808
tcc gaa gag Ser Glu Glu			Arg			e Ála				5856
agt gag aac Ser Glu Asn 1955	Phe Ser									5904
tcc tcc act Ser Ser Thr 1970			Ser 3	_		l Thr	_	-		5952
agc gat aac Ser Asp Asn 1985				Ser Asp				Glu		6000
ctc gcc gac Leu Ala Asp		Pro Ser					Ser	Ile		6048
	2005	•		2010			2	2015		
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<211> 2016 <212> PRT <213> Homo <400> 4 Met Ala Asn 1 Thr Arg Glu	sapiens  Phe Leu 5  Ser Leu 20  Ser Thr	Leu Pro Ala Ala Thr Leu	Ile (Gln (40	Gly Thr 10 Glu Lys 25 Glu Ser	Arg Me	t Ala u Gly 45	Arg Glu 30 Leu	Arg 15 Lys Pro	Gln Glu	
<pre>&lt;211&gt; 2016 &lt;212&gt; PRT &lt;213&gt; Homo &lt;400&gt; 4 Met Ala Asn 1 Thr Arg Glu Ala Arg Gly 35</pre> Glu Glu Ala	sapiens  Phe Leu 5  Ser Leu 20  Ser Thr	Leu Pro Ala Ala Thr Leu Pro Glr 55	Ile (Gln (40	Gly Thr 10 Glu Lys 25 Glu Ser Asp Leu	Arg Me Arg Gl Gln Al	t Ala u Gly 45 a Ser 0	Arg Glu 30 Leu Lys	Arg 15 Lys Pro Lys	Gln Glu Leu	
<pre>&lt;211&gt; 2016 &lt;212&gt; PRT &lt;213&gt; Homo &lt;400&gt; 4 Met Ala Asn 1 Thr Arg Glu Ala Arg Gly 35 Glu Glu Ala 50 Pro Asp Leu</pre>	sapiens  Phe Leu 5  Ser Leu 20  Ser Thr  Pro Arg	Leu Pro Ala Ala Thr Leu Pro Glr 55 Asn Pro 70 Phe Tyr	Ile (Gln (40 Leu Pro (	Gly Thr 10 Glu Lys 25 Glu Ser Asp Leu Gln Glu	Arg Me Arg Gl Gln Al 6 Leu Il 75	t Ala u Gly 45 a Ser 0	Arg Glu 30 Leu Lys Glu	Arg 15 Lys Pro Lys Pro	Glu Leu Leu 80	
<pre>&lt;211&gt; 2016 &lt;212&gt; PRT &lt;213&gt; Homo &lt;400&gt; 4 Met Ala Asn 1 Thr Arg Glu Ala Arg Gly 35 Glu Glu Ala 50 Pro Asp Leu 65</pre>	sapiens  Phe Leu Ser Leu 20 Ser Thr Pro Arg Tyr Gly Asp Pro	Leu Pro Ala Ala Thr Leu Pro Glr 55 Asn Pro 70 Phe Tyr	Gln (40 Leu A Pro (	Gly Thr 10 Glu Lys 25 Glu Ser Asp Leu Gln Glu Thr Gln 90	Arg Me Arg Gl Gln Al 6 Leu Il 75 Lys Th	t Ala u Gly 45 a Ser 0 e Gly	Arg Glu 30 Leu Lys Glu Ile	Arg 15 Lys Pro Lys Pro Val 95	Glu Leu Leu 80 Leu	

Val His Ser Leu Phe Asn Met Leu Ile Met Cys Thr Ile Leu Thr Asn 135 Cys Val Phe Met Ala Gln His Asp Pro Pro Pro Trp Thr Lys Tyr Val Glu Tyr Thr Phe Thr Ala Ile Tyr Thr Phe Glu Ser Leu Val Lys Ile Leu Ala Arg Ala Phe Cys Leu His Ala Phe Thr Phe Leu Arg Asp Pro 185 Trp Asn Trp Leu Asp Phe Ser Val Ile Ile Met Ala Tyr Thr Thr Glu 200 Phe Val Asp Leu Gly Asn Val Ser Ala Leu Arg Thr Phe Arg Val Leu Arg Ala Leu Lys Thr Ile Ser Val Ile Ser Gly Leu Lys Thr Ile Val Gly Ala Leu Ile Gln Ser Val Lys Lys Leu Ala Asp Val Met Val Leu Thr Val Phe Cys Leu Ser Val Phe Ala Leu Ile Gly Leu Gln Leu Phe Met Gly Asn Leu Arg His Lys Cys Val Arg Asn Phe Thr Ala Leu Asn Gly Thr Asn Gly Ser Val Glu Ala Asp Gly Leu Val Trp Glu Ser Leu Asp Leu Tyr Leu Ser Asp Pro Glu Asn Tyr Leu Leu Lys Asn Gly Thr Ser Asp Val Leu Leu Cys Gly Asn Ser Ser Asp Ala Gly Thr Cys Pro Glu Gly Tyr Arg Cys Leu Lys Ala Gly Glu Asn Pro Asp His Gly Tyr Thr Ser Phe Asp Ser Phe Ala Trp Ala Phe Leu Ala Leu Phe Arg Leu 360 Met Thr Gln Asp Cys Trp Glu Arg Leu Tyr Gln Gln Thr Leu Arg Ser Ala Gly Lys Ile Tyr Met Ile Phe Phe Met Leu Val Ile Phe Leu Gly 395 Ser Phe Tyr Leu Val Asn Leu Ile Leu Ala Val Val Ala Met Ala Tyr 405 410 Glu Glu Gln Asn Gln Ala Thr Ile Ala Glu Thr Glu Glu Lys Glu Lys Arg Phe Gln Glu Ala Met Glu Met Leu Lys Lys Glu His Glu Ala Leu Thr Ile Arg Gly Val Asp Thr Val Ser Arg Ser Ser Leu Glu Met Ser 455

Pro Leu Ala Pro Val Asn Ser His Glu Arg Arg Ser Lys Arg Arg Lys 475 470 Arg Met Ser Ser Gly Thr Glu Glu Cys Gly Glu Asp Arg Leu Pro Lys 490 Ser Asp Ser Glu Asp Gly Pro Arg Ala Met Asn His Leu Ser Leu Thr Arg Gly Leu Ser Arg Thr Ger Met Lys Pro Arg Ser Ser Arg Gly Ser Ile Phe Thr Phe Arg Arg Arg Asp Leu Gly Ser Glu Ala Asp Phe Ala 535 Asp Asp Glu Asn Ser Thr Ala Arg Glu Ser Glu Ser His His Thr Ser Leu Leu Val Pro Trp Pro Leu Arg Arg Thr Ser Ala Gln Gly Gln Pro 570 565 Ser Pro Gly Thr Ser Ala Pro Gly His Ala Leu His Gly Lys Lys Asn Ser Thr Val Asp Cys Asn Gly Val Val Ser Leu Leu Gly Ala Gly Asp 600 605 Pro Glu Ala Thr Ser Pro Gly Ser His Leu Leu Arg Pro Val Met Leu 615 Glu His Pro Pro Asp Thr Thr Pro Ser Glu Glu Pro Gly Gly Pro Gln Met Leu Thr Ser Gln Ala Pro Cys Val Asp Gly Phe Glu Glu Pro 650 Gly Ala Arg Gln Arg Ala Leu Ser Ala Val Ser Val Leu Thr Ser Ala Leu Glu Glu Leu Glu Glu Ser Arg His Lys Cys Pro Pro Cys Trp Asn Arg Leu Ala Gln Arg Tyr Leu Ile Trp Glu Cys Cys Pro Leu Trp Met 695 Ser Ile Lys Gln Gly Val Lys Leu Val Val Met Asp Pro Phe Thr Asp Leu Thr Ile Thr Met Cys Ile Val Leu Asn Thr Leu Phe Met Ala Leu 730 Glu His Tyr Asn Met Thr Ser Glu Phe Glu Glu Met Leu Gln Val Gly 745 740 Asn Leu Val Phe Thr Gly Ile Phe Thr Ala Glu Met Thr Phe Lys Ile Ile Ala Leu Asp Pro Tyr Tyr Tyr Phe Gln Gln Gly Trp Asn Ile Phe Asp Ser Ile Ile Val Ile Leu Ser Leu Met Glu Leu Gly Leu Ser Arg 795

- Met Ser Asn Leu Ser Val Leu Arg Ser Phe Arg Leu Leu Arg Val Phe 805 810 815
- Lys Leu Ala Lys Ser Trp Pro Thr Leu Asn Thr Leu Ile Lys Ile Ile 820 825 830
- Gly Asn Ser Val Gly Ala Leu Gly Asn Leu Thr Leu Val Leu Ala Ile 835 840 845
- Ile Val Phe Ile Phe Ala Val Val Gly Met Gln Leu Phe Gly Lys Asn 850 855 860
- Tyr Ser Glu Leu Arg Asp Ser Asp Ser Gly Leu Leu Pro Arg Trp His 865 870 875 880
- Met Met Asp Phe Phe His Ala Phe Leu Ile Ile Phe Arg Ile Leu Cys 885 890 895
- Gly Glu Trp Ile Glu Thr Met Trp Asp Cys Met Glu Val Ser Gly Gln 900 905 910
- Ser Leu Cys Leu Leu Val Phe Leu Leu Val Met Val Ile Gly Asn Leu 915 920 925
- Val Val Leu Asn Leu Phe Leu Ala Leu Leu Leu Ser Ser Phe Ser Ala 930 935 940
- Asp Asn Leu Thr Ala Pro Asp Glu Asp Arg Glu Met Asn Asn Leu Gln 945 950 955 960
- Leu Ala Leu Ala Arg Ile Gln Arg Gly Leu Arg Phe Val Lys Arg Thr 965 970 975
- Thr Trp Asp Phe Cys Cys Gly Leu Leu Arg His Arg Pro Gln Lys Pro 980 985 990
- Ala Ala Leu Ala Ala Gln Gly Gln Leu Pro Ser Cys Ile Ala Thr Pro 995 1000 1005
- Tyr Ser Pro Pro Pro Pro Glu Thr Glu Lys Val Pro Pro Thr Arg Lys 1010 1015 1020
- Glu Thr Gln Phe Glu Glu Gly Glu Gln Pro Gly Gln Gly Thr Pro Gly 1025 1030 1035 1040
- Asp Pro Glu Pro Val Cys Val Pro Ile Ala Val Ala Glu Ser Asp Thr 1045 1050 1055
- Asp Asp Glu Glu Asp Glu Glu Asn Ser Leu Gly Thr Glu Glu Glu 1060 1065 1070
- Ser Ser Lys Gln Gln Glu Ser Gln Pro Val Ser Gly Trp Pro Arg Gly 1075 1080 1085
- Pro Pro Asp Ser Arg Thr Trp Ser Gln Val Ser Ala Thr Ala Ser Ser 1090 1095 1100
- Glu Ala Glu Ala Ser Ala Ser Gln Ala Asp Trp Arg Gln Gln Trp Lys 1105 1110 1115 1120
- Ala Glu Pro Gln Ala Pro Gly Cys Gly Glu Thr Pro Glu Asp Ser Cys 1125 1130 1135

- Ser Glu Gly Ser Thr Ala Asp Met Thr Asn Thr Ala Glu Leu Leu Glu 1140 1145 1150
- Gln Ile Pro Asp Leu Gly Gln Asp Val Lys Asp Pro Glu Asp Cys Phe 1155 1160 1165
- Thr Glu Gly Cys Val Arg Arg Cys Pro Cys Cys Ala Val Asp Thr Thr 1170 1180
- Gln Ala Pro Gly Lys Val Trp Trp Arg Leu Arg Lys Thr Cys Tyr His 1185 1190 1195 1200
- Ile Val Glu His Ser Trp Phe Glu Thr Phe Ile Ile Phe Met Ile Leu 1205 1210 1215
- Leu Ser Ser Gly Ala Leu Ala Phe Glu Asp Ile Tyr Leu Glu Glu Arg 1220 1225 1230
- Lys Thr Ile Lys Val Leu Leu Glu Tyr Ala Asp Lys Met Phe Thr Tyr 1235 1240 1245
- Val Phe Val Leu Glu Met Leu Leu Lys Trp Val Ala Tyr Gly Phe Lys 1250 1255 1260
- Lys Tyr Phe Thr Asn Ala Trp Cys Trp Leu Asp Phe Leu Ile Val Asp 1265 1270 1275 1280
- Val Ser Leu Val Ser Leu Val Ala Asn Thr Leu Gly Phe Ala Glu Met 1285 1290 1295
- Gly Pro Ile Lys Ser Leu Arg Thr Leu Arg Ala Leu Arg Pro Leu Arg 1300 \$1305\$
- Ala Leu Ser Arg Phe Glu Gly Met Arg Val Val Asn Ala Leu Val 1315 1320 1325
- Gly Ala Ile Pro Ser Ile Met Asn Val Leu Leu Val Cys Leu Ile Phe 1330 1340
- Trp Leu Ile Phe Ser Ile Met Gly Val Asn Leu Phe Ala Gly Lys Phe 1345 1350 1355 1360
- Gly Arg Cys Ile Asn Gln Thr Glu Gly Asp Leu Pro Leu Asn Tyr Thr 1365 1370 1375
- Ile Val Asn Asn Lys Ser Gln Cys Glu Ser Leu Asn Leu Thr Gly Glu 1380 1385 1390
- Leu Tyr Trp Thr Lys Val Lys Val Asn Phe Asp Asn Val Gly Ala Gly 1395 1400 1405
- Tyr Leu Ala Leu Gln Val Ala Thr Phe Lys Gly Trp Met Asp Ile 1410 1415 1420
- Met Tyr Ala Ala Val Asp Ser Arg Gly Tyr Glu Glu Gln Pro Gln Trp 1425 1430 1435 1440
- Glu Tyr Asn Leu Tyr Met Tyr Ile Tyr Phe Val Ile Phe Ile Ile Phe 1445 1450 1455
- Gly Ser Phe Phe Thr Leu Asn Leu Phe Ile Gly Val Ile Ile Asp Asn  $1460 \hspace{1.5cm} 1465 \hspace{1.5cm} 1470$

- Phe Asn Gln Gln Lys Lys Leu Gly Gly Gln Asp Ile Phe Met Thr 1475 1480 1485
- Glu Glu Gln Lys Lys Tyr Tyr Asn Ala Met Lys Lys Leu Gly Ser Lys 1490 1495 1500
- Lys Pro Gln Lys Pro Ile Pro Arg Pro Leu Asn Lys Tyr Gln Gly Phe 1505 1510 1515 1520
- Ile Phe Asp Ile Val Thr Lys Gln Ala Phe Asp Val Thr Ile Met Phe 1525 1530 1535
- Leu Ile Cys Leu Asn Met Val Thr Met Met Val Glu Thr Asp Asp Gln 1540 1545 1550
- Ser Pro Glu Lys Ile Asn Ile Leu Ala Lys Ile Asn Leu Leu Phe Val 1555 1560 1565
- Ala Ile Phe Thr Gly Glu Cys Ile Val Lys Leu Ala Ala Leu Arg His 1570 1575 1580
- Tyr Tyr Phe Thr Asn Ser Trp Asn Ile Phe Asp Phe Val Val Val Ile 1585 1590 1595 1600
- Leu Ser Ile Val Gly Thr Val Leu Ser Asp Ile Ile Gln Lys Tyr Phe 1605 1610 1615
- Phe Ser Pro Thr Leu Phe Arg Val Ile Arg Leu Ala Arg Ile Gly Arg 1620 1625 1630
- Ile Leu Arg Leu Ile Arg Gly Ala Lys Gly Ile Arg Thr Leu Leu Phe 1635 1640 1645
- Ala Leu Met Met Ser Leu Pro Ala Leu Phe Asn Ile Gly Leu Leu 1650 1650 1660
- Phe Leu Val Met Phe Ile Tyr Ser Ile Phe Gly Met Ala Asn Phe Ala 1665 1670 1680
- Tyr Val Lys Trp Glu Ala Gly Ile Asp Asp Met Phe Asn Phe Gln Thr 1685 1690 1695
- Phe Ala Asn Ser Met Leu Cys Leu Phe Gln Ile Thr Thr Ser Ala Gly 1700 1705 1710
- Trp Asp Gly Leu Leu Ser Pro Ile Leu Asn Thr Gly Pro Pro Tyr Cys 1715 1720 1725
- Asp Pro Thr Leu Pro Asn Ser Asn Gly Ser Arg Gly Asp Cys Gly Ser 1730 1735 1740
- Pro Ala Val Gly Ile Leu Phe Phe Thr Thr Tyr Ile Ile Ser Phe 1745 1750 1755 1760
- Leu Ile Val Val Asn Met Tyr Ile Ala Ile Ile Leu Glu Asn Phe Ser 1765 1770 1775
- Val Ala Thr Glu Glu Ser Thr Glu Pro Leu Ser Glu Asp Asp Phe Asp 1780 1785 1790
- Met Phe Tyr Glu Ile Trp Glu Lys Phe Asp Pro Glu Ala Thr Gln Phe 1795 1800 1805

- Ile Glu Tyr Ser Val Leu Ser Asp Phe Ala Asp Ala Leu Ser Glu Pro 1810 1815 1820
- Leu Arg Ile Ala Lys Pro Asn Gln Ile Ser Leu Ile Asn Met Asp Leu 1825 1830 1835 1840
- Pro Met Val Ser Gly Asp Arg Ile His Cys Met Asp Ile Leu Phe Ala 1845 1850 1855
- Phe Thr Lys Arg Val Leu Gly Glu Ser Gly Glu Met Asp Ala Leu Lys 1860 1865 1870
- Ile Gln Met Glu Glu Lys Phe Met Ala Ala Asn Pro Ser Lys Ile Ser 1875 1880 1885
- Tyr Glu Pro Ile Thr Thr Leu Arg Arg Lys His Glu Glu Val Ser 1890 1895 1900
- Ala Met Val Ile Gln Arg Ala Phe Arg Arg His Leu Leu Gln Arg Ser 1905 1910 1915 1920
- Leu Lys His Ala Ser Phe Leu Phe Arg Gln Gln Ala Gly Ser Gly Leu 1925 1930 1935
- Ser Glu Glu Asp Ala Pro Glu Arg Glu Gly Leu Ile Ala Tyr Val Met 1940 1945 1950
- Ser Glu Asn Phe Ser Arg Pro Leu Gly Pro Pro Ser Ser Ser Ile 1955 1960 1965
- Ser Ser Thr Ser Phe Pro Pro Ser Tyr Asp Ser Val Thr Arg Ala Thr 1970 1975 1980
- Ser Asp Asn Leu Gln Val Arg Gly Ser Asp Tyr Ser His Ser Glu Asp 1985 1990 1995 2000
- Leu Ala Asp Phe Pro Pro Ser Pro Asp Arg Asp Arg Glu Ser Ile Val 2005 2010 2015